US005836792A

United States Patent [19]

Thumma et al.

[11] **Patent Number: 5,836,792**

[45] **Date of Patent: Nov. 17, 1998**

[54] **BOARD MOUNTABLE ELECTRICAL CONNECTOR**

[75] Inventors: **Mark Richard Thumma**, Oberlin; **Daniel Gerard Grab**, Harrisburg; **Charles Dudley Cooper**, Harrisburg; **Matthew Moo Uoong Cho**, Harrisburg; **Ricky Edward Brown**, Lykens, all of Pa.

[73] Assignee: **The Whitaker Corporation**, Wilmington, Del.

[21] Appl. No.: **756,859**

[22] Filed: **Nov. 26, 1996**

[51] **Int. Cl.**[6] **H01R 13/405**

[52] **U.S. Cl.** **439/736**

[58] **Field of Search** 439/733.1, 869, 439/637, 745, 736

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,513,499	4/1985	Roldan	439/733.1
4,553,322	11/1985	Cappos et al.	29/739
4,904,212	2/1990	Durbin et al.	439/751
5,409,404	4/1995	Reed	439/736
5,462,456	10/1995	Howell	439/733.1

OTHER PUBLICATIONS

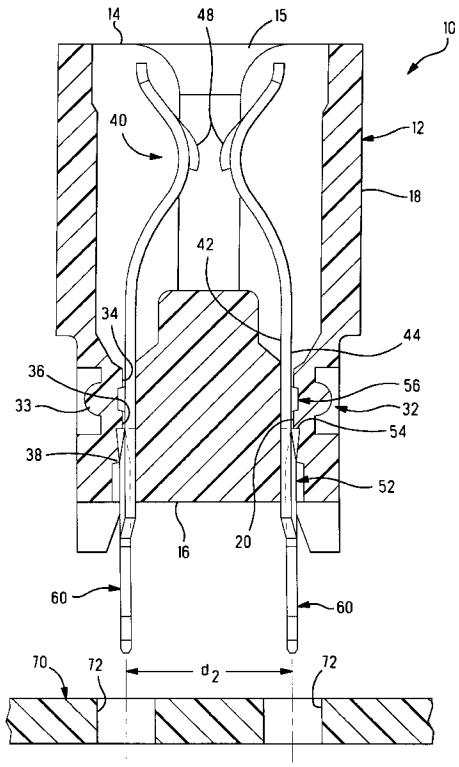
AMP One–Piece Printed Circuit Board Connectors Catalog 82619—Streamlined 1–92 (Published 1992) pp. 2, 16, 17, 25.

Primary Examiner—Neil Abrams
Assistant Examiner—Eugene G. Byrd
Attorney, Agent, or Firm—Katherine A. Nelson

[57] **ABSTRACT**

A connector **(10)** including a housing **(12)** and a plurality of terminals **(40)** extending in respective passageways **(30)** through the housing **(12)** from a mating face **(14)** to a board-mounting face **(16)** , the terminals **(40)** having board-mounting sections **(60)** extending beyond the board-mounting face **(16)** . Each passageway **(30)** has a preselected dimension from an outer housing wall **(20)** to an inner housing wall **(26)** . Each terminal **(40)** has a thickness dimension less than the passageway dimension. The board-mounting section **(60)** and at least a portion of the body section **(50)** of the terminal **(40)** adjacent thereto is embossed laterally from the plane of the body section a selected distance. Upon staking the terminals **(40)** in the respective passageways **(30)** , the embossed portion **(52)** of each terminal **(40)** is disposed adjacent the outer housing wall **(20)** and the remaining portion of the body section **(50)** is disposed adjacent an inner housing wall **(26)** . Thus terminals **(40)** formed of thin stock are usable with the housing and stakable thereto, while the board-mounting sections thereof remain accurately positioned with terminal-receiving holes **(72)** of a circuit board **(70)** .

3 Claims, 5 Drawing Sheets



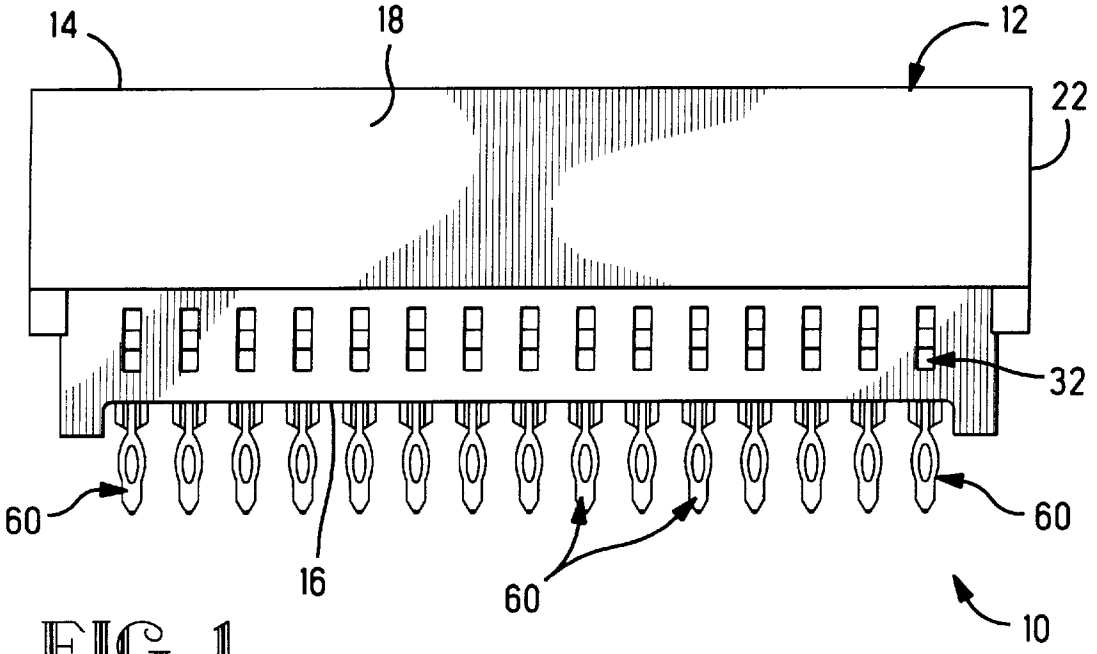


FIG. 1

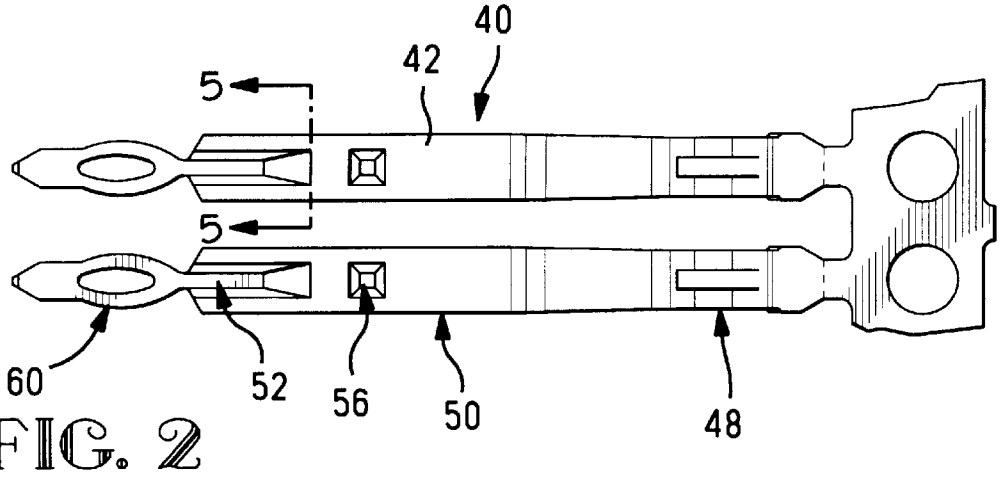


FIG. 2

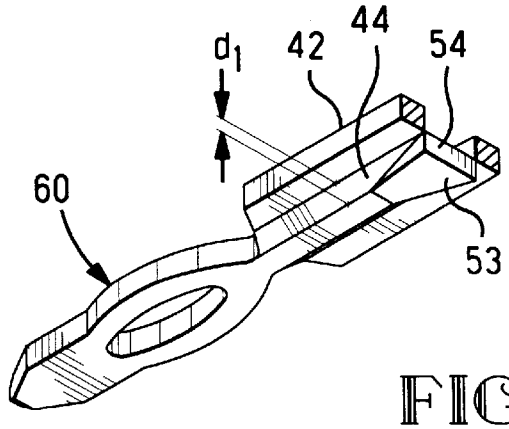


FIG. 5

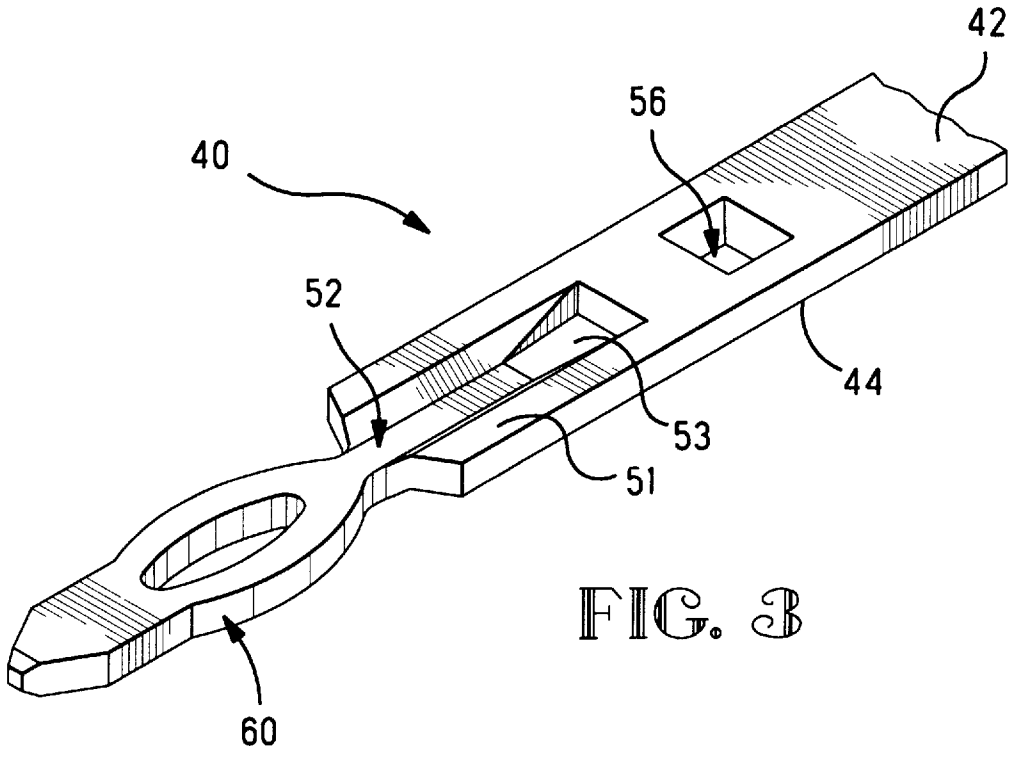


FIG. 3

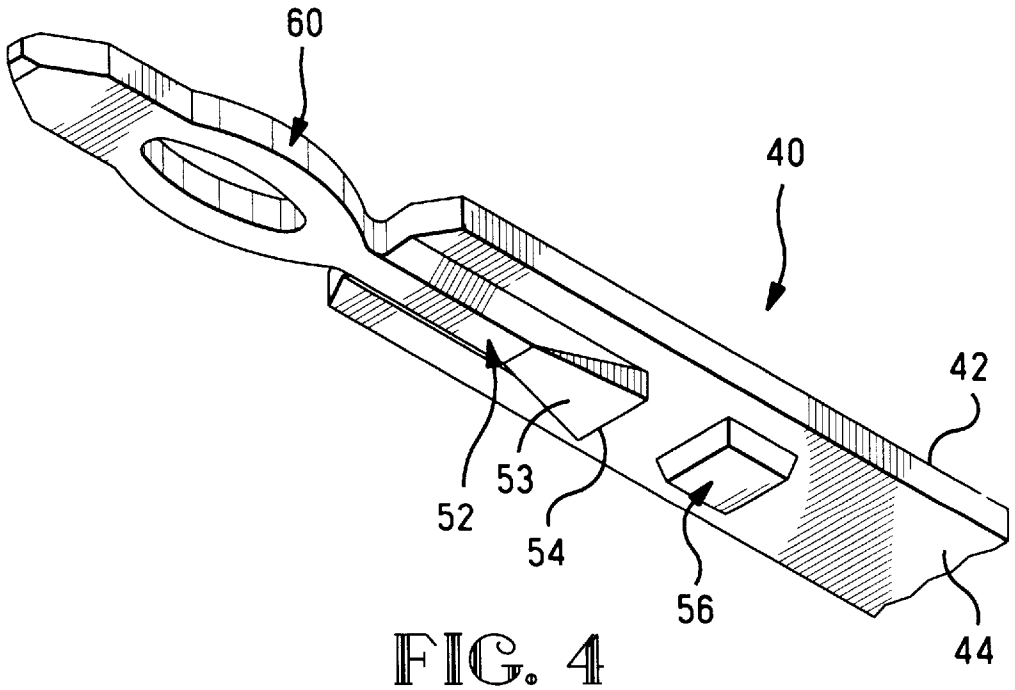


FIG. 4

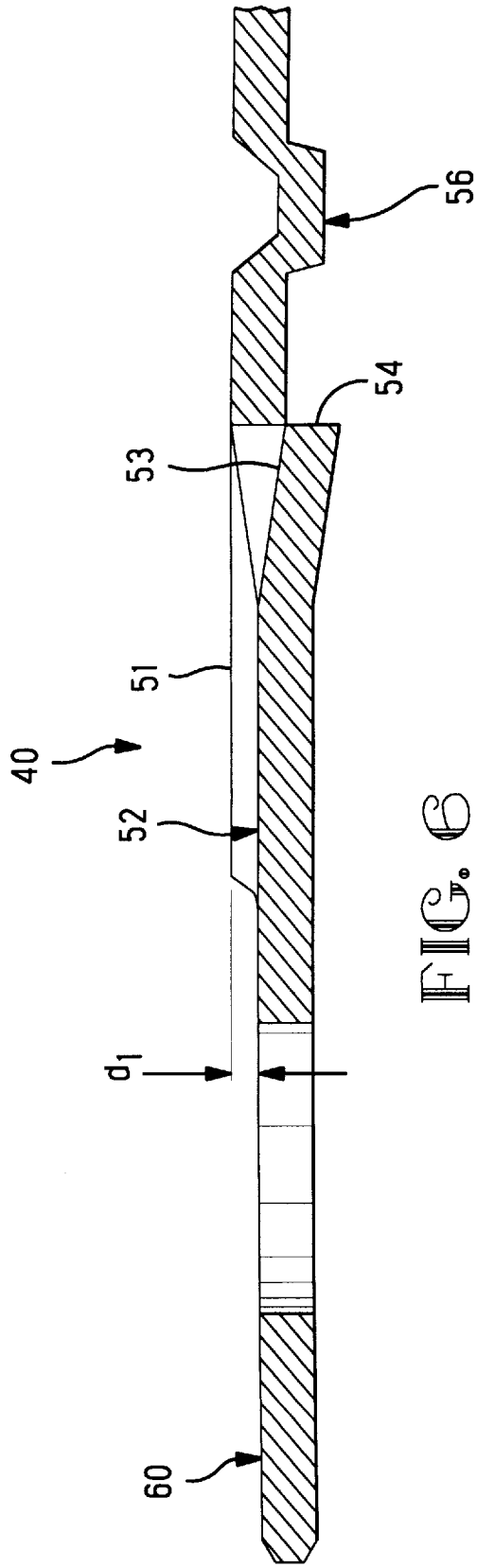


FIG. 6

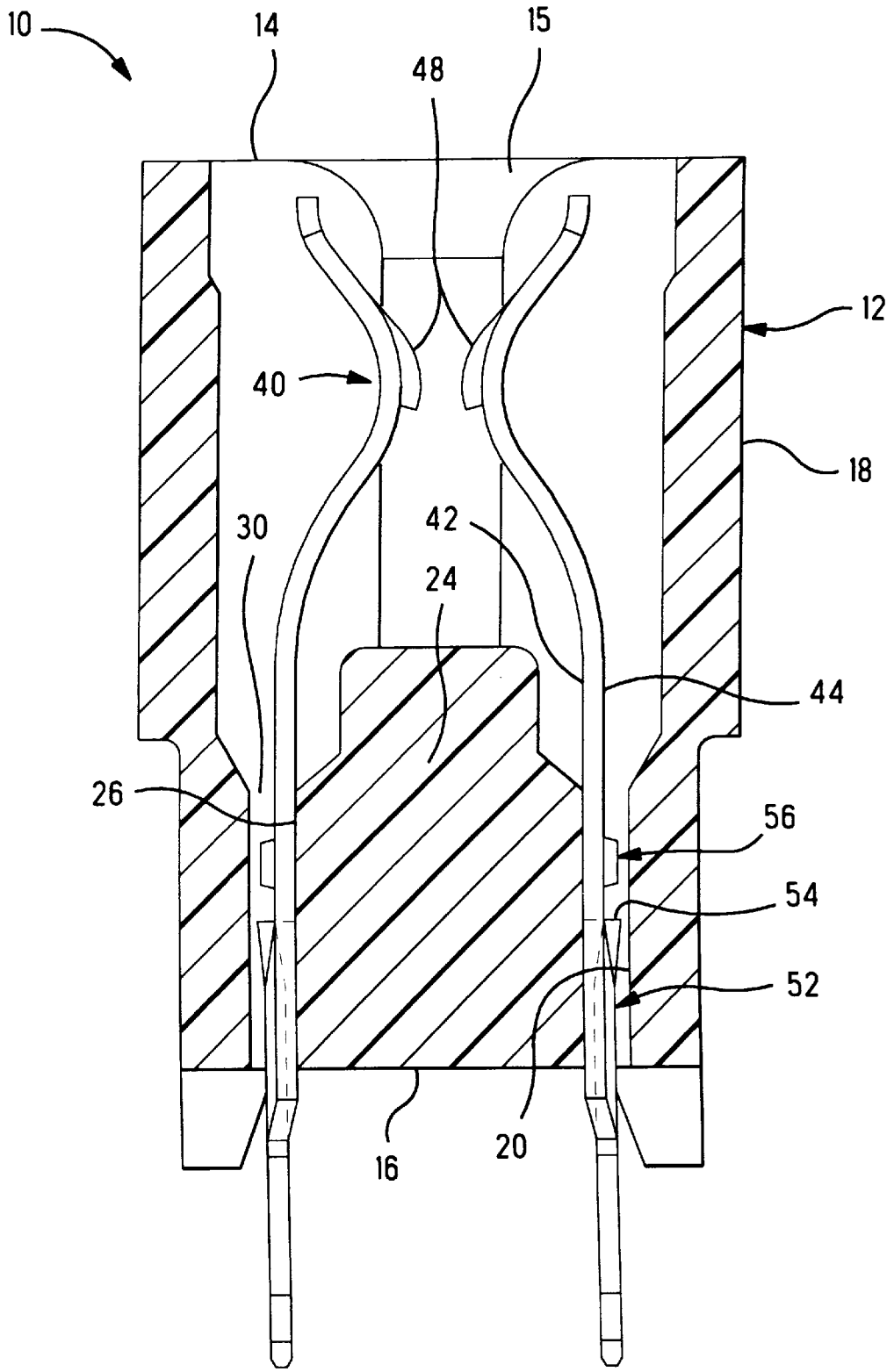


FIG. 7

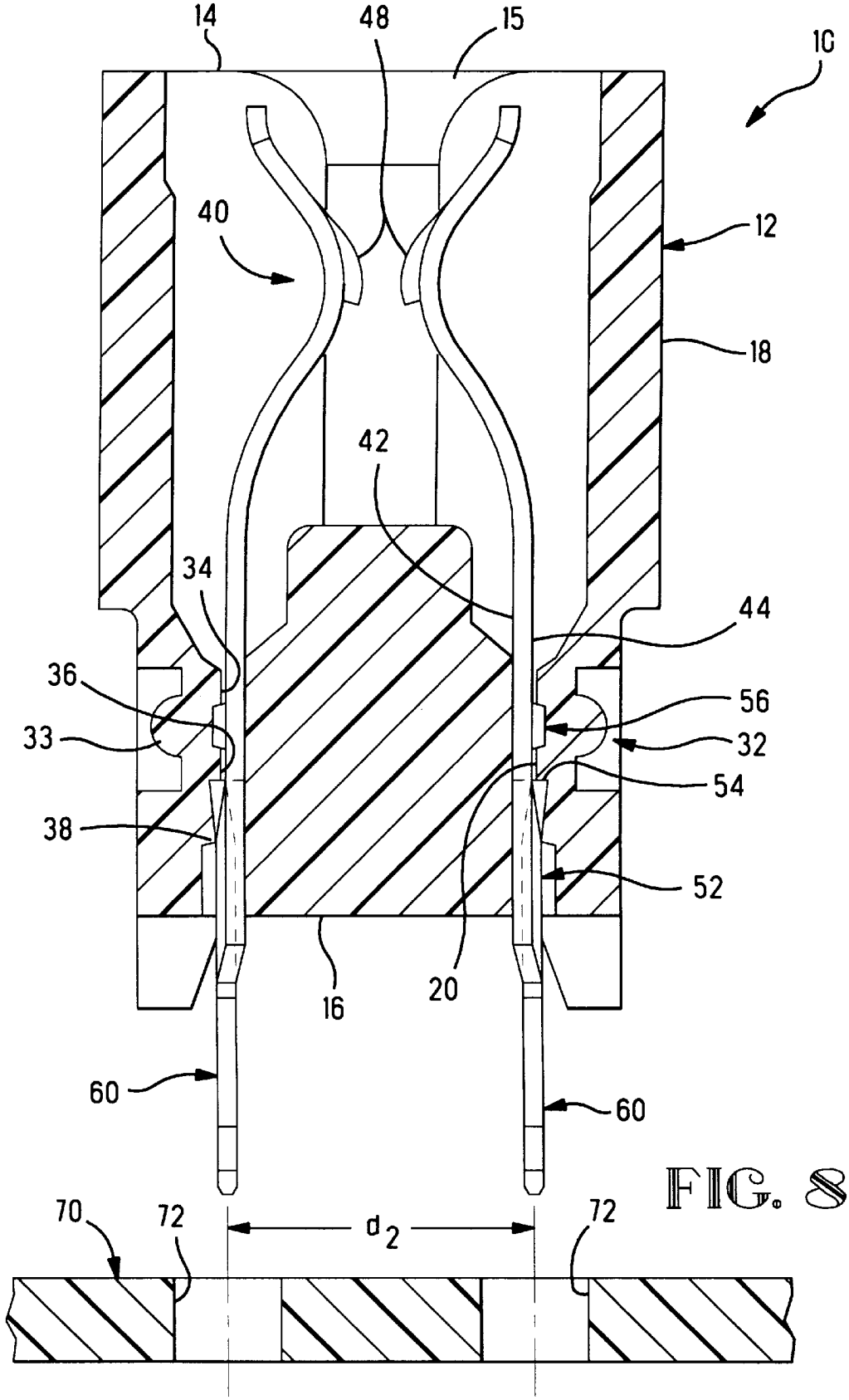

14
48
15
10
40
12
18
42
34
44
36
56
33
32
54
38
52
16
20
60
60
70
72
d_2
72

FIG. 8

BOARD MOUNTABLE ELECTRICAL CONNECTOR

FIELD OF THE INVENTION

This invention is directed to electrical connectors and more particularly to board mountable electrical connectors.

BACKGROUND OF THE INVENTION

In manufacturing electrical connectors that are to be mounted to circuit boards, it is essential that the board-mounting sections of the electrical terminals at the board mounting face of the housing be accurately positioned with respect to the corresponding array of terminal-receiving holes of a circuit board. For cost effective manufacturing of the connectors, it is desirable that the board-mounting sections have compliant portions rather than solder leads, thus eliminating the need for soldering the connector to the board. Furthermore, for cost effective manufacturing, it is desirable that the electrical connector be mountable to the circuit board by applying pressure from a flat tool to the top of the housing in what is known as a "flat rock" assembly technique. The design of the compliant section will vary with the thickness of the stock used for the terminals, the number of terminals in the electrical connector and the desired insertion force, as known in the art.

The thickness of the stock used for the terminals in the connector is determined by the amount of spring force and other characteristics desired for the terminal at the mating face of the connector and the current carrying capability required by the end user. Thus, the same style of connector can be manufactured with terminals having a variety of stock thicknesses. Typically, connectors have been made with housings that are designed to receive a specific thickness of terminals wherein the housing has terminal retention portions within the passageway to assure that the terminal is held in the proper location for mounting to a circuit board. Alternatively, the housing can be formed with an essentially straight passageway wherein the terminal is staked. To stake terminals into the housing, force is applied to a tool on the outside edge of the housing, which forces some of the housing material against configured areas of the terminal thereby forcing the housing material around the configured areas and the terminal body section against an adjacent inner housing wall. The staking method, while suitable with stock thicknesses that are approximately the width of the passageway, may not provide sufficient retention to hold the terminal in the passageway to resist the force generated during the flat rock insertion process. With thin stock terminals, there is the additional problem of the board-mounting section collapsing or buckling rather than moving into the hole of the board. Additionally, the thin board mounting sections may not have the same center-line spacing that was achieved with terminals made from thicker stock.

To reduce inventory and for cost effective manufacturing, it is desirable to be able to use the same housing for terminals having different stock thicknesses while retaining the capability to flat rock the connector to the board, maintain a desired centerline spacing for the connector regardless of the thickness of the terminals used in the connector housing, and provide sufficient column strength to the terminal to enable the use of compliant board-mounting sections to eliminate the soldering process.

SUMMARY OF THE INVENTION

The present invention is directed to a connector that alleviates the problems of the prior art. The connector has an

insulating housing with a plurality of terminal-receiving passageways extending therethrough from a mating face to a board mounting face and a plurality of terminals disposed in respective passageways. Each passageway has a preselected dimension from an outer to an inner housing wall and are in position to be aligned with terminal-receiving holes of a circuit board. The terminals include boardmounting sections extending beyond the board-mounting face and terminal body sections disposed in and secured in the housing by staking. In accordance with the present invention, the terminals have a thickness dimension that is associated with and less than the preselected passageway dimension. Each terminal including the board-mounting section and at least a portion of the body section thereof adjacent thereto is embossed laterally from the plane of the body section a selected distance such that the board-mounting section will be properly positioned in the passageway and aligned with a board hole. After staking, the embossed area is disposed adjacent the outer housing wall while a remaining portion of the body section is disposed adjacent the inner housing wall. Terminals formed of thin stock, therefore, can be used in the housing and are stakable thereto, while the board-mounting sections remain accurately positioned with the terminal receiving holes. The embossed area furthermore strengthens the terminal column to permit the compliant board-mounting sections to be inserted into the terminal-receiving holes.

It is an object of the present invention to provide a connector that will accept terminals made in different stock thicknesses while maintaining accuracy of the board mounting sections with respect to the terminal-receiving holes of a circuit board.

It is a further object of the invention to provide a terminal having a thickness dimension less than the width of an associated housing passageway that can be secured in the passageway such that accurate positioning is maintained while enabling the assembly to be inserted by a flat rock technique.

It is another object of the invention to provide terminals that can be formed of thin stock for desired characteristics at the mating face yet have sufficient rigidity at the compliant board-mounting section to be mounted to a board without collapsing.

It is yet another object of the invention to have a cost effective manufacturing and assembly process.

An embodiment of the invention will now be described with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a connector made in accordance with the invention

FIG. **2** is a plan view of a strip of terminals made in accordance with the invention.

FIG. **3** is an isometric view of a fragmentary portion of the terminal of FIG. **2** illustrating one side of a terminal body and board mounting section.

FIG. **4** is a view similar to FIG. **3** showing the other side of the terminal.

FIG. **5** is an isometric view taken along the line **5–5** of FIG. **2**.

FIG. **6** is a longitudinal sectional view of the terminal made in accordance with the invention.

FIG. **7** is a cross-sectional view of the housing having a terminal therein prior to staking of the terminals.

FIG. **8** is a view similar to FIG. **7** after the terminals have been staked in the housing.

DETAILED DESCRIPTION OF THE DRAWINGS

For purposes of illustrating the invention, the terminal will be described for use in a card edge connector. It is to be understood that the terminal design may be used with other connectors that are to be mounted to circuit boards.

Referring now to FIGS. **1** through **8**, connector **10** includes a housing **12** having a plurality of terminal receiving passageways **30** and a plurality of terminals **40** disposed therein. Housing **12** includes a mating face **14**, an opposed mounting face **16**, sidewalls **18** and endwalls **22**. Housing **12** further includes an inner wall **24**, as best seen in FIGS. **7** and **8**. The plurality of terminal receiving passageways **30** extend between the mating and mounting faces **14**, **16**, respectively and are defined proximate the mounting face **16** by inner surface **20** of outer wall **18** and the surface **26** of inner wall **24**. As can be seen in FIG. **7**, the walls **20** and **26** in the lower passageway portion are devoid of retention features for the terminal **40**. Each passageway **30** has preselected dimension from the outer housing wall **20** to the inner housing wall **26**.

Each terminal **40** includes a first major surface and an opposed second major surface **44**. Terminal **40** has a thickness dimension that is associated with but less than the dimension of passageway **30** of connector housing **12**, as best seen in FIG. **7**. Terminal **40** includes a body **50** having a mating section **48** at one end thereof and a board mounting section **60** at the opposite end thereof. Each terminal **40** further includes at least a first embossment **52** extending outwardly from major surface **44**. The first embossment **52** includes the board mounting section **60** and at least a portion **51** of the body section **50** adjacent to the board mounting section **60**. The first embossment **52** further includes an outwardly directed protrusion **53** formed by shearing the uppermost end thereof. Protrusion **53** forms a push shoulder **54** as best seen in FIGS. **5** and **6**. The first embossment **52** extends laterally from the plane of the body section a selected distance d_1 to assure that the board mounting section **60** will be accurately positioned with relationship to the circuit board holes upon securing the terminal **40** in housing passageway **30**, as best seen in FIGS. **5** and **6**. For example, when using a terminal having a thickness of 12.5×10^{-3} inches in a passageway dimensioned to accommodate terminals having a thickness of $25\times10^{31\ 3}$ inches, the board-mounting section would be shifted a lateral distance of about 6.3×10^{-3} inches. In the preferred embodiment, terminal **40** further includes a second embossment **56** spaced above the first embossment **52** on body section **50**.

The first embossment, furthermore, strengthens the terminal column to permit the compliant board-mounting sections to be inserted into the terminal-receiving holes. The force required to insert compliant sections can be on the order of 8–15 pounds or greater per terminal. If the column is not sufficiently strong, the terminal will buckle instead of moving into a terminalreceiving hole of the board.

FIGS. **7** and **8** show terminals **40** disposed in respective passageways **30** before and after staking respectfully. As can be seen from these Figures, major surface **42** of terminal **40** lies adjacent the inner surface **26** of inner wall **24** and major surface **44** with the outwardly laterally extending embossments **52**, **56** is disposed adjacent surface **20** of the outer housing wall **18**. After staking at location **32**, as shown in FIG. **8**, the housing material is pushed against major surface **44** at locations **34**, **36** and **38**, with material at **34** being above the second embossment **56**, the material at **36** being between the push surface **54** of the first embossment **52** and the second embossment **56** and the material at **38** lying along a portion of the first embossment **52** below the push surface **54**.

As can be seen from FIG. **8**, the present invention assures that the center line spacing d_2 between the respective pairs of board mounting section **60** is the same as the spacing d_2 between the associated terminal receiving holes **72** of a circuit board **70**. The movement of housing material around the first and second embossments **52** and **56** of the terminals **40** resulting from the staking operation provide sufficient retention force to assure that each terminal **40** is securely held in the housing and has a greater retention force than the resistance encountered when the connector **10** is flat rock inserted to a circuit board **70**. The outwardly extending push shoulder **54** provides a surface of housing material **36** that helps to push the compliant board mounting section **60** into the associated terminal receiving or through-hole **72** of board **70**. In accordance with the invention, no special tool needs to be used to apply direct force to each individual terminal.

In manufacturing connector **10** in accordance with the present invention, a standard housing **12** is molded from suitable materials, as known in the art. Terminals **40** are stamped and formed in a strip from stock having the desired thickness. To facilitate assembly of the terminals **40** into the housing **12**, the housing is placed in a fixture dimensioned to position the board-mounting sections **60** at the selected distance from the mounting face **16** of the housing. The terminals **40** attached to a carrier strip are mass inserted into the respective terminal-receiving passageways **30** in housing **12** with the ends of the board-mounting sections **60** against the fixture and the carrier strip is removed. The connector **10**, having the terminals **40** inserted therein, is then passed through a staking station in the assembly line where the terminals **40** are staked in the desired location. The staking operation assures that the major surface **42** is securely held against the inner wall surface **26** and the board-mounting sections **60** are in proper alignment with the circuit board holes **72**.

The present invention provides a terminal that is formed of thin stock and is stakable in a housing having terminal-receiving passageways that are dimensioned larger than the thickness of the stock from which the terminal is formed. The present invention further assures that the corresponding board-mounting sections are accurately positioned for mounting to a circuit board.

It is thought that the board mountable electrical connector of the present invention and many of its attendant advantages will be understood from the foregoing description. It is apparent that various changes may be made in the form, construction, and arrangement of parts thereof without departing from the spirit or scope of the invention or sacrificing all of its material advantages.

We claim:

1. A connector of the type having an insulative housing including a plurality of passageways extending therethrough from a mating face to a board-mounting face and positioned to be aligned with terminal-receiving holes of a circuit board, with each passageway having a preselected dimension from an outer housing wall to an inner housing wall, and a plurality of terminals extending from mating sections at the mating face through respective passageways to board-mounting sections extending beyond the board-mounting face, with terminal body sections disposed in and along the passageways to be secured in the housing by staking of the outer housing wall against the terminal body sections adjacent the inner housing wall, characterized in that:

said terminals each having a thickness dimension associated with and less than the preselected passageway dimension, each said terminal including the board-

mounting section thereof and at least a portion of the body section thereof adjacent thereto being embossed laterally from the plane of the body section a selected distance, a remaining portion of the body section being disposed adjacent the inner housing wall, said outer housing wall having a portion staked into engagement with said embossed body portion of said terminal therby pressing said body section against said inner wall;

whereby the terminals formed of thin stock are usable with the housing and stakable thereto, while the board-mount sections thereof remain accurately positioned with the terminal receiving holes.

2. The connector of claim **1** wherein a portion of an innermost end of said embossed body portion is sheared from said body section to form an outwardly extending portion defining a rearwardly facing push surface, which cooperates with said housing after the terminal has been staked in the housing, thereby permitting said connector to be mounted to a circuit board by applying force to the top of the connector housing, which in turn applies force to the respective push surfaces to urge the associated board-mounting section of each said terminal into a respective terminal-receiving hole.

3. The connector of claim **1** wherein said board-mounting section of each said terminal includes a compliant portion, said embossed body portion providing sufficient column strength to each said terminal to permit said connector to be mounted to said board by applying force to the top of said housing.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,836,792
DATED : November 17, 1998
INVENTOR(S) : Mark Richard Thumma et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page;
Correct spelling of inventor name:

[75] Charles Dudley Copper

Signed and Sealed this

Ninth Day of March, 1999

Attest:

Q. TODD DICKINSON

Attesting Officer

Acting Commissioner of Patents and Trademarks